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Mr. Chairman, Members of the Committee, my name is Dennis Campbell and I am the President and CEO of Ballard Power Systems. Thank you for the opportunity to speak with you today on a subject of central importance to today's pressing energy, economic, and environmental challenges.

Ballard is recognized as the world leader in developing and manufacturing proton exchange membrane or PEM fuel cells. We've been developing PEM fuel cells since 1983 and hold nearly 1,000 patents, granted and pending, on some of the most fundamental fuel cell technologies.

We are the exclusive fuel cell supplier to Ford Motor Company and DaimlerChrysler and to date have supplied eight of the top 10 automotive manufacturers. Today, Ballard fuel cells power more customer demonstration vehicles than all other fuel cell developers combined.

Based on our more than 20 years of research, development and extensive over-the-road experience, we've concluded – and I believe each of the major automotive manufacturers would agree - that hydrogen fuel cells will be the automotive powertrain of the 21st century.

Fuel cells have the power to transform our world because they offer a comprehensive solution to the most pressing problems of our time: energy security, global climate change, urban air quality, and long-term energy supply.

In addition to these obvious benefits, a fuel cell powered automobile is also simpler to build, inherently more reliable with fewer moving parts, and has the potential to be feature rich, more versatile and more fun to drive.

At Ballard our corporate vision statement is "Power to change the world". While that may sound like a lofty statement, there are those who would take it a step further and state that fuel cells in fact, have the power to save the world.

The fact is, the hydrogen economy is not just some Utopian dream, it is an opportunity that is within our reach. The building blocks are here today, and we have clear line of sight to solutions that will meet the remaining technical challenges.

As with any disruptive technology, there are legions of critics, those who prefer the status quo, those for whom the glass is always half empty.

When I was a student at the University of Oklahoma in 1967, the Senator from New York came to our campus for a talk. That night, Bobby Kennedy said something that has stayed with me all these years and continues to inspire me today. He said:

"Some men see things as they are and ask 'Why?'
I dream things that never were and ask, 'Why not?'"

At Ballard we are focused on "why not." We're focused on solving problems, on advancing the technology, on meeting the challenges.

We are responding to those who claim that fuel cell technology is, and will remain, prohibitively expensive; that onboard fuel storage is too difficult; that a hydrogen refueling infrastructure is too much trouble; or that it takes too much energy to produce hydrogen.

We're focused on providing evidence, not opinion. Let me offer some data to set the record straight.

Last year, before the House Science Committee, Dr. Joseph Romm, a leading critic of fuel cell technology, claimed that PEM fuel cell costs were about 100 times greater than the cost of a comparable internal combustion engine and that a major technology breakthrough would be needed in transportation fuel cells before they would be practical.[1]

The truth is that from 1999 to 2003, at Ballard we reduced the cost of our fuel cell by 80% while achieving a ten-fold increase in lifetime. By 2004, we reduced the cost of our fuel cell, adjusted for high volume production, to $103 dollars per kilowatt – that's only a bit more than three times higher than the commercial target the Department of Energy has set for 2010. Our goal this year is to get down to $85, and we're confident that by 2010 we can achieve DOE's target of $30 per kilowatt.

This is not unlike developments in the computer industry. In 1956, a gigabyte of memory cost $10 million. By 1980, the cost had been reduced to $193,000 per gigabyte. Today, the cost is about $1.15.

The hydrogen delivery infrastructure, cited by many critics as an insurmountable obstacle, is merely an engineering problem. There are already more than 100 fueling stations in place around the world. The estimated cost for broad deployment of a hydrogen fueling infrastructure in the US is variously estimated at between $10 and $20 billion - not much more than the $11 billion that the industry reportedly spends each year to simply maintain its present gasoline delivery system.

[1] Dr. Joseph Romm before the House Science Committee, March 3, 2004.

With respect to on-board storage of hydrogen, progress is being made with higher pressure tanks, purpose built vehicles, and the investigation of solid storage media.

Governments are assembling the building blocks of the hydrogen economy in fuel cell vehicle demonstrations throughout the world. Through these demonstrations, citizens are gaining exposure to hydrogen and fuel cell vehicles and the promise of clean, energy independent transportation.

One such demonstration is the Department of Energy's Fleet Validation program. Ballard, through its automotive partners Ford and DaimlerChrysler, will be powering approximately 60 vehicles in this initiative in various locations throughout the U.S., generating important data and experience that will directly advance the technology.

Another highly successful demonstration program is the European Fuel Cell Bus Project. Since 2003, Ballard fuel cells have been powering 30 Mercedes-Benz Citaro buses in daily revenue service in 10 different cities. This program is co-financed by the European Union.

To date, more than 3.5 million passengers have ridden these Ballard powered buses, putting them in direct contact, *today*, with clean, quiet and efficient hydrogen-fueled transportation. In London, Mayor Ken Livingstone embraces these fuel cell buses as part of his initiative to reduce ambient noise levels in the city.

In addition to the European program, six other Ballard powered transit buses are operating in Perth, Australia and Santa Clara, California with three more scheduled for Beijing later this year.

Through these and other demonstrations, Ballard fuel cells are powering more than 130 vehicles on four different continents, approximately three quarters of all publicly demonstrated fuel cell vehicles on road today.

As we move from demonstrations to a commercially viable fuel cell product for the automotive sector, there are four key technical challenges to be overcome: reducing the cost, increasing the durability, ensuring reliable startup in freezing temperatures, and doing so within the available package space.

Ballard has a plan to overcome each of these challenges… what we call our technology "road map", our public commitment to demonstrate commercially-viable automotive fuel cell stack technology by 2010. This "road map" is fully aligned with the DOE's published commercial targets for this technology.

Let me first address fuel cell cost. Meeting DOE's 2010 cost target of $30 per kW will ensure that a fuel cell engine is cost competitive with today's internal combustion engines. There are a number of factors that affect fuel cell cost. Two of the most challenging are the amount of platinum used in the catalyst, and the type of membrane used in the fuel cell construction. Ballard has done significant research and development to reduce the amount of platinum we use. In 2004 we demonstrated a 30% reduction without compromise to performance, efficiency or

durability. We are also looking at a number of membrane chemistries and constructions to significantly reduce the cost of this critical component. We believe we are on track to achieve the DOE target of $30 per kilowatt by 2010.

Durability is the second key technical challenge we face. The DOE has set a 2010 commercial target of 5,000 hours – about 150,000 miles which is roughly equivalent to the lifetime of today's internal combustion engines. As with the cost challenge, membrane design and material is a key factor in fuel cell lifetime. Last year, we demonstrated automotive fuel cell technology with a lifetime of 2,200 hours. Many of the Ballard-powered fuel cell buses operating as part of the European Fuel Cell Bus Project have achieved more than 2,500 hours of operation. We have a stationary fuel cell – our cogeneration system for residential usage in Japan - that has achieved more than 25,000 hours of lifetime. We are confident that we can deliver the DOE target of 5,000 hours by 2010.

The third technical challenge is to improve the ability of our fuel cells to start in freezing temperatures. The electrochemical reaction within a fuel cell produces water and heat. Managing that water in sub-freezing temperatures is essential to a successful start-up. Our advanced simulation tools and testing methods have provided us with insight and a fundamental understanding of how water behaves through the various cycles of fuel cell operation. Last year, we demonstrated technology that was able to start at -20° Celsius, reaching 50% of the rated power within 100 seconds. Our goal for 2010 is to demonstrate start-up from -30° Celsius, reaching 50% of the rated power in 30 seconds. The DOE target for 2010 is -20° Celsius, reaching 50% of the rated power in 30 seconds.

Power density, is an important boundary condition that constrains the previous three goals to ensure that the solutions can be packaged within the limited vehicle space available. Last year, we demonstrated fuel cell technology at 1,200 watts per liter net. The DOE's 2010 commercial target is 2,000 watts per liter net. As in the case of freeze start, we've actually set a more stringent target for ourselves, at 2,200 watts per liter net, based on our customers' requirements, and we're confident that we can achieve that.

To summarize: we know what the technical challenges are, we have multiple technology paths that we are pursuing, and we are confident that we will demonstrate commercially-viable automotive fuel cell stack technology by 2010.

The single most important determinant of when fuel cells will be commercially available for automotive application is the will and commitment of government. If the role of government is to protect and serve its people, there is no better investment for government to make than an all-out, Apollo-like commitment to hydrogen and fuel cells.

The President's Hydrogen Initiative has galvanized industry and government in support of the hydrogen economy, and continues to facilitate public-private sector collaboration.

Though I believe a higher overall funding commitment is appropriate, the pending energy bill's important R&D and Demonstration programs will strengthen the President's initiative and, if fully appropriated, provide a push at a crucial stretch along the commercialization timeline.

Yet I urge Congress to take a further step. A national strategy to accelerate the hydrogen economy must not only have strong R&D and Demonstration programs but also a robust transition to market plan that provides a bridge to commercialization. Only government intervention can overcome the classic chicken and egg problem and kick-start the transition to a hydrogen economy. The proposed $1,000 per kilowatt tax credit for stationary fuel cells is a good beginning – but more must be done to support vehicular fuel cell introduction.

The framework of an effective transition to market program for fuel cell *vehicles* is present in legislation sponsored earlier this year by Senators Dorgan and Graham, and is also captured in the energy bill's Vehicles and Fuels provision. I strongly recommend that Congress elevate, expand, and significantly increase funding for this procurement program for fuel cell vehicles. A strong procurement program aimed at fuel cell vehicles for federal and state fleets must be in place, along side R&D and Demonstrations, as a third component of the national strategy to accelerate the hydrogen economy.

Broadcast early enough and with sufficiently clear guidelines, a clear commitment by the Congress to make a specific and sizable annual outlay for the fiscal years 2010 to 2015 on federal and state fleet procurement of fuel cell vehicles would: (a) support early volume production by automotive OEMs and suppliers that is necessary to drive cost down; (b) support the build out of hydrogen infrastructure; (c) draw additional private capital into the sector, and (d) provide the American public with a large scale introduction to the hydrogen economy.

In closing, let me say that the challenges are real – but they can and will be met.

Thank you for the opportunity to appear before you today. I look forward to any questions you may have.